C·R·E·S®
CENTER FOR REPRODUCTION OF ENDANGERED SPECIES

REPORT
FALL 2000

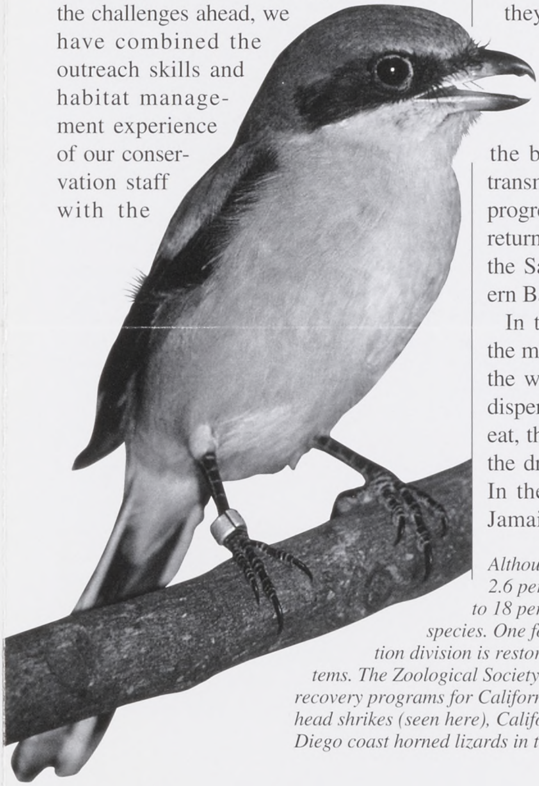
CRES® is operated by the Zoological Society of San Diego.

Focus on the Field: Ecology and Applied Conservation Join Forces

The recovery and preservation of the world's declining and sensitive flora and fauna is an immense effort, requiring the integration of research, education, and policy on a broad scale. This year, the CRES ecology division merged with the applied conservation department to form a new unit within CRES, devoted specifically to the conservation of endangered species in their native habitats. To help CRES meet the challenges ahead, we have combined the outreach skills and habitat management experience of our conservation staff with the scientific background and expertise of our ecology research team.

The work of the CRES ecology and applied conservation division is focused on three broad wildlife conservation themes. The first of these is reintroduction of keystone species to their natural environments. As scavengers unparalleled in their size and flight capabilities, California condors are exquisitely evolved for the ecosystems they inhabit. In collaboration with the Zoological Society's bird department, our group is leading the effort to restore this magnificent species to its native habitat. Once the birds are released, we use satellite-transmitter radiotelemetry to monitor their progress in the wild. This year, we hope to return condors to their ancestral habitat in the San Pedro Martír Mountains of northern Baja California.

In the Caribbean, we are reintroducing the most endangered lizards in the world to the wild. Because Caribbean rock iguanas disperse the seeds of the native plants they eat, their loss has serious consequences for the dry tropical forests in which they live. In the British Virgin Islands, Cuba, and Jamaica, we are collaborating with local



Although San Diego County comprises only 2.6 percent of California's land base, it is home to 18 percent of the state's rare and endangered species. One focus of the ecology and applied conservation division is restoration of our native species to their ecosystems. The Zoological Society of San Diego is an integral partner in recovery programs for California condors, San Clemente Island loggerhead shrikes (seen here), California least terns, snowy plovers, and San Diego coast horned lizards in the wild.

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Bud Heller Fellow for 2000
Rhino studies under way in the virology/immunology division at CRES.
See page 4.

Support CRES through Estate Planning
Consider a gift of long-term appreciated stock.
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Come for Celebration for the Critters!
The "wildest" party in town is on September 23 at the San Diego Zoo.
See back cover.

Focus on the Field: Ecology and Applied Conservation Join Forces

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conservationists to headstart young iguanas by rearing them in safe environments until they reach a less vulnerable body size. Locating these programs on site not only allows juvenile iguanas to grow under natural conditions but also provides us with valuable opportunities for public outreach and education. This year, we will undertake a large-scale rescue-and-recovery program to relocate 1,000 iguanas from an island slated for development to eight protected cays in the Turks & Caicos Islands.

Other species for which we are coordinating intensive captive propagation and reintroduction efforts are the critically endangered San Clemente Island loggerhead shrike and the giant Chacoan peccary in Paraguay. To date, more than 150 shrikes have been hatched at the San Diego Zoo's breeding center on San Clemente. As a result of the ongoing efforts of the Zoo's Avian Propagation Center, the CRES behavior division, and a team of Navy-sponsored biologists, the shrike program reached a milestone this year, with released birds successfully reproducing in the wild for the first time. Although the main focus of the Paraguay program remains the peccary, we are expanding our efforts to include the peccary's unique and increasingly threatened habitat, the Gran Chaco, home to rare jaguars, giant anteaters, and maned wolves.

G. Gerber

Our second conservation theme is that of sustainable use. To this end, we are working with local communities to help develop programs that provide significant income, while at the same time promoting conservation of natural resources. In Madagascar and Costa Rica, we are teaching butterfly ranching and farming techniques, activities that provide an economic incentive for the protection of healthy, intact ecosystems. Ecotourism is another enterprise that can empower local people to earn their livelihood in a way that is compatible with conservation. Working with the Society's education department, we are developing the infrastructure and educational framework needed to support the Bosque Modelo Mariposa Madre Reserve in Mexico, one of the largest overwintering sites for monarch butterflies in the world.

Finally, closer to home, we continue to play an important role in the conservation of Southern California's increasingly threatened natural areas. San Diego is home to more species of endemic plants than any other county in the continental United States. At the same time, our county contains more threatened and endangered species than any other on the continent, the vast majority of which are plants. This year, we constructed a straw-bale seed bank facility at the Wild Animal Park to store seeds from key locations throughout San Diego County for propagation and revegetation efforts. Additional functions include establishment of an invaluable research collection for botanists wishing to study our unique flora, as well as provision of a safety net against extinction of endangered plant species.

In collaboration with biologists at the University of California, Riverside, we are studying the effects of restoration of local sage scrub habitats on the distribution and ecology of native vertebrates, using the San Diego coast horned lizard as a model species. Given that sage scrub habitats have been reduced to less than 15 percent of their original extent, understanding how native animals respond to habitat restoration techniques is critical for effective conservation and enhancement of what remains. We are also overseeing habitat management and nest site monitoring for California least terns and snowy plovers at several coastal locations ranging from Camp Pendleton to the Chula Vista Wildlife Reserve. We continue to be involved in a variety of educational outreach efforts aimed at communicating local habitat value to fellow San Diegans and encouraging them to experience our remarkable wildlife firsthand.

This division also promotes sustainable economic practices in developing countries by teaching butterfly ranching, a pursuit whose profits are tightly linked to the quality of the ecosystem. We also offer sustainably produced goods in the San Diego Zoo and Wild Animal Park gift shops that are carefully researched to ensure they benefit both animal and human communities in countries such as Costa Rica and Madagascar.

It is the diversity of interest, experience, and expertise that comes with the joining of ecology and applied conservation that makes possible this broad array of programs and approaches. Together, we look forward to an exciting future of active conservation in the field.

Allison Alberts, Ph.D., Division Head,
Ecology and Applied Conservation/CRES

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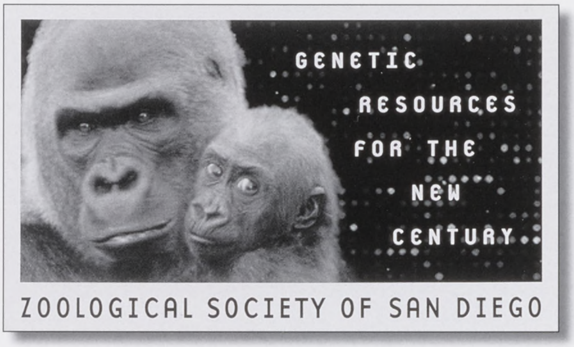


Genetics

Zoos know that access to animals in the wild is rapidly decreasing: their habitats are being diminished, fragmented, and exploited in an unsustainable manner. Yet, information derived from species such as primates is essential for uncovering what is human about human biology. Recognition of the importance of genetic resources—which provide the basis for genomic investigations—is made more urgent by their vulnerability in the face of economic development.

One of the Zoological Society of San Diego's major initiatives is to conserve genetic resources from a growing diversity of species. Accordingly, a conference titled Genetic Resources for the New Century was held from May 7-11, 2000, in La Jolla, California. This conference represented a departure from the usual way of doing genomic biodiversity research, whether it involved genetic resource banking, developing methodologies in the field of biomedical sciences, or the community of zoological parks and wildlife conservation organizations. This gave us an opportunity to link together the scientific aspects of conservation with public awareness.

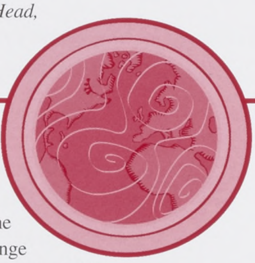
An international group of speakers, bioethicists, and key contributors to global conservation attended, scientists prominent for their innovative and far-reaching research contributions. Access to genetic resources was highlighted as a global concern. A striking new opportunity for linking *ex situ* and *in situ* conservation was advanced. It was also agreed that Web-based DNA libraries contribute significantly to efforts to assess, monitor, manage, and recover endangered species.

The Zoological Society is actively exploring the design of a Web site to collect information about DNA banks. While there are many more species that are threatened with extinction or that are becoming extinct without being named, our initial efforts focus upon learning how many endangered species are represented in DNA collections and whether they are accessible. We have already exchanged some information with collections in Cape Town, South Africa, in Paris, France, in Göttingen, Germany, and in Kunming, China.

The conference proceedings will be published as a book in 2001, which should broaden the dialogue about the impact of genomic sciences on our understanding of biology and the urgent need to preserve genetic material for future study. This meeting also created an informal network among the participants, leading to a more coordinated effort for collecting and sharing information. It is our sincere hope that this new knowledge opens up a wider discussion on genomic biodiversity conservation via academic seminars, follow-up conferences, and discussions within the conservation community. This can establish links between conservation organizations and biodiversity management programs as well as the genomics/biotechnology/pharmaceutical industries.

The Zoological Society of San Diego is proud to have initiated this effort and continues to educate our members and guests at our Frozen Zoo site: www.sandiegozoo.org/cres/frozen.html. This site also holds our Genetic Resource List, a comprehensive list of samples available to the scientific community. It is one way that CRES can encourage dialogue and an exchange of information in a field that is critically important for the future of endangered species.

Oliver Ryder, Ph.D., Division Head,
Genetics/CRES



CRES Grants

The Center for Reproduction of Endangered Species is grateful to the following for their support of imperiled wildlife:

The **BNGF Podlich/Fisher Charitable Gift Fund** gave a grant to be applied toward a field study of the owl monkey in Argentina. The **John and Beverly Stauffer Foundation** gave a grant in support of genetic study of gorillas. The ecology and applied conservation division of CRES received funds for construction of the seed bank facility at the Wild Animal Park from the **Brotman Foundation of California**, the **Weingart/Price Fund**, the **Mandell Weiss Charitable Trust**, the **McCarthy Family Foundation**, and the **J. M. Long Foundation**.

Recent grants in support of the **Beckman Foundation's** challenge to construct a new CRES facility at the Wild Animal Park were made by the **Offield Family Foundation**, the **George Hoag Family Foundation**, the **Ellen Browning Scripps Foundation**, and the **Hugh and Emily Morris Foundation**. The **International Rhino Foundation** and **SOS Rhino** gave grants to support field research on reproduction in southern white rhinos in South Africa.

Bud Heller Conservation Fellowship: A Focus on Black Rhinos

As recently as a year ago, Betty Jensen was conducting genetic crosses of the malaria vector, *Anopheles gambiae*, looking for a genetic basis of insecticide resistance. These days, as the Bud Heller Fellow for the year 2000, she is involved in molecularly cloning and sequencing the DNA of specific genes of the immune system that allows an individual to fight off infectious microorganisms. She is also busy codiscovering novel herpesviruses that may play some causative role in a variety of diseases seen in the species on which she works. But rather than working on six-legged invertebrates as she has for the last 20 years, Betty is now focusing her energy on helping sustain the captive population of the critically endangered *Diceros bicornis*, the black rhinoceros.

Betty Jensen, the Bud Heller Fellow for the year 2000, is seen applying polymerase chain reaction (PCR) products to an electrophoresis gel for DNA analysis. Individual DNA bands, separated with this basic technique, will be molecularly cloned and sequenced. Betty is applying these techniques to studies of rhinoceros herpesviruses and immune system genes.

Established by the Heller Foundation of San Diego in memory of the late Bud Heller, the Heller Conservation Fellowship is awarded annually to an individual who will be working in one of the divisions at CRES, specifically on a species kept at the San Diego Wild Animal Park. The virology/immunology division of CRES pursues, as one of its priorities, an understanding of the immune system of rhinoceroses and the infectious agents that potentially threaten their long-term existence in captivity. Working with Dr. Michael Worley, head of the division, and Holly Trotter, research laboratory coordinator, Betty is applying a variety of molecular biological techniques to both identify rhinoceros-specific genes for subsequent analysis and for the discovery of novel pathogens.

Rhinoceroses diverged from their fellow odd-toed ungulates (horses, zebras, asses, and tapirs) approximately 55 million years ago. Once represented by more than 70 genera and filling every niche available to large mammalian herbivores, rhinoceroses are now limited to 5 extant species. As part of a global conservation strategy, some of these species are being intensively managed in national parks, sanctuaries, or zoological parks. One of the highest priorities for research on the black rhinoceros is to understand the genetic basis and causative factors of the many diseases seen in this species in captivity. These diseases include, among others, acute hemolytic anemia, chronic nonhemolytic anemia, hemorrhagic vasculopathy, fungal pneumonia, necrolytic dermatitis, mycobacterial infections, and chronic nonspecific weight loss.

Whether there are specific individuals or subpopulations of the species that are more or less likely to develop one or all of these diseases is unknown. Betty has been involved with determining the DNA sequence and level of genetic variation, among individuals, of two immune system genes that bind foreign proteins and present them to responsive cells. By utilizing genomic DNA samples isolated from the blood of more than 100 individual black rhinos, she and her co-workers have been looking for genetic patterns among these animals and will attempt to correlate these patterns with the presence or absence of specific diseases.

In addition to this extremely challenging project, Betty has been intensively involved with the discovery and partial sequencing of three novel herpesviruses that have been detected in blood or tissue-specific cell lines of the black rhinoceros. Herpesviruses are widespread in nature and cause a broad spectrum of diseases, some of which are similar to those seen in this species. Betty has been instrumental in developing assays for the specific detection of these viruses in the blood of living animals, and the molecular epidemiological data that emerges from this study may establish connections between viral infections and specific diseases.

Although the Heller Conservation Fellowship is awarded for only a 12-month period, Betty has already made significant contributions to better understanding disease issues in a highly endangered species. There is no doubt that the remainder of her fellowship will be as productive.

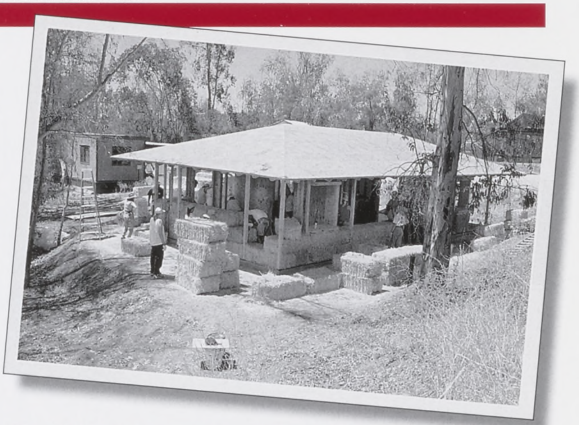
Michael Worley, D.V.M., Division Head,
Virology/Immunology at CRES

A Unique Seed Bank in San Diego

Southern California is a region of great biological diversity, with more than 2,000 native plant species found nowhere else in the world. This is also a region with recent unparalleled growth of human development, home to one of the fastest-growing populations in the country. One habitat type, coastal sage scrub, once covered much of the Los Angeles Basin and extended down to San Diego County. Today, less than 15 percent of coastal sage and its unique plants and animals remain. The case for conserving indigenous plant species is no less urgent than that for animal species. In response to this need for natural resource conservation and protection, the CRES ecology and applied conservation division launched the first seed bank program in our region, and it will be jointly maintained with the Park's horticulture staff. It is dedicated to conserving and propagating rare native plants for reintroduction into buffer zones between designated habitat preserves and human development projects.

The seed bank has been built at the San Diego Wild Animal Park and is the centerpiece of our endangered plant propagation program for native San Diego County plants. Society horticulturists are working to determine and collect genetically suitable plant material, cultivate plant species on Park property, and test cultivation methods to produce robust growth at lower cost and lower failure rate. The program will focus on sensitive plant communities such as coastal sage scrub, southern maritime chaparral, mule-fat scrub, and southern riparian scrub. Sensitive declining plant taxa will be collected for conservation and propagation, especially in advance of approved grading projects in San Diego County. By serving as a repository and supplier of seeds, the Society offers a conservation tool that preserves the integrity of our local native habitat. In some cases, it may be the only available option to preserve the last of a plant species.

Precise mapping of collection sites is done by a satellite-based Global Positioning System (GPS), with emphasis on the most threatened habitats. Seeds of threatened and endangered plants are gathered and catalogued, and these are made available to a team responsible for revegetation of disturbed sites. It will also be available to students from our on-campus public school at the Wild Animal Park, so they may visit the seed bank as they learn about habitat conservation. The U.S. Fish and Wildlife Service and local clients are very supportive of this concept, because the program makes plants easily available for investigation, evaluation, and restoration projects. This unique seed bank at the Wild Animal Park promises to fill the future needs of both conservationists and developers in Southern California.



Straw bales stack up as a remarkable building material. They are produced from a waste product, are biodegradable, durable, and easy to maintain. The two-foot-thick, straw-bale walls are covered with stucco, creating a stable environment where temperatures fluctuate only 5 degrees during the year—ideal for seed storage. The Zoological Society's seed bank has 880 square feet of space for the collection and long-term storage of seeds from hundreds of species of plants native to San Diego County. Collected seeds are placed in a drying room at 60 degrees Fahrenheit and about 15 percent relative humidity. Once dry, they are cleaned, counted, and stored in airtight containers. All information is entered into a computer data base for storage, with the seed list made available to universities, land managers, and regulatory agencies. The seed bank will serve as a repository for endangered seeds as well as a community resource for revegetation projects.

Stock Market Butterflies?

If the stock market's recent volatility has you concerned, consider the advantages of a charitable gift of long-term appreciated securities. Many friends of CRES have supported its conservation and research programs through the years in a variety of wonderful ways. By far the most cost-effective method, however, has been the use of long-term appreciated stock as a charitable contribution. Consider the benefits:

- You are eligible for a tax deduction for the fair market value of your stock on the date you gift it—no matter what you originally paid.
- You avoid capital gains taxation that would apply if you sold it.
- You may become eligible for the benefits of Circle status.
- You make a significant contribution to support the Center for Reproduction of Endangered Species.

Whether you choose to make an outright gift, bequest, or if you would like more information about gifts to CRES that provide you with lifetime income, we are available to assist you in satisfying both your charitable and financial goals. For information, please contact the Development Office at (619) 231-1515, ext. 4245, or write to us at the Zoological Society of San Diego, P.O. Box 120551, San Diego, CA 92112.

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- Feast on the beastly bounty from San Diego's finest restaurants and beverage vendors
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- Meet Zoo Goodwill Ambassador Joan Embery and her animal friends

And—swinging entertainment, Skyfari rides, opportunity drawing, games, critter encounters, special Zoo photos, faux tattoos, Celebration merchandise, *and much more!*

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Proceeds benefit CRES, the Zoological Society's Center for Reproduction of Endangered Species.

Happy Anniversary, CRES!

Guests must be 21 or older to attend. Children and strollers not permitted.

Visit our Web site for the latest information at www.sandiegozoo.org.

CRES REPORT
CENTER FOR REPRODUCTION OF ENDANGERED SPECIES

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